Sir:

This responds to the October 16, 2003 Advisory Action, in which the Examiner refused to reconsider the claim rejections finalized in the July 30, 2003 Final Office Action in the above-identified patent application. No amendment has been made herein, and all the pending claims 1-9 and 35-42 are retained unchanged as in the previously filed Response dated May 20, 2003.

REMARKS

Rejection of Claims on Reference Grounds, and Traversal Thereof

In the October 16, 2003 Advisory Action, the Examiner asserted that "Hiroharu discloses a GaN-based HEMT having an InGaN channel layer and an n-AlGaN layer with mole fraction of Al of 0.2" and that "Streit et al. disclosed a partially relaxed channel and teach a partially relaxed channel would allow a thicker channel layer, which lead to a higher speed device." Based on such assertions, the Examiner drew the conclusion that "[the] combination of Hiroharu and Streit et al. is proper and meets the limitations of claim 1" (see the Advisory Action).

Applicants respectfully disagree, because the hypothetical combination of Hiroharu and Streit et al. suggested by the Examiner, regardless of whether such hypothetical combination is proper or not, does not teach each and every element of claim 1, from which claims 2-9 and 35-42 depend, and the Examiner has not established a *prima facie* case of unpatentability against the pending claims of the present application.

Claim 1 of the present application, from which claims 2-9 and 35-42 depend, expressly recites:

> "A gallium nitride-based HEMT device, comprising **a channel layer comprising an InGaN alloy** and **at least one additional layer over said channel layer**, wherein said at least one additional layer comprises material selected from the group consisting of **AlGaN, GaN, and InGaN, with the proviso that when said at least one additional layer comprises AlGaN material, said AlGaN material is $Al_xGa_{1-x}N$, wherein x is less than 0.2**."

In order to satisfy his initial burden of presenting a *prima facie* case of obviousness, the Examiner has to provide evidentiary evidence to show:

(1) Prior art reference(s) teach or suggest a gallium nitride-based HEMT device having a InGaN channel layer and an AlGaN layer over such channel layer, while the AlGaN layer comprises **$Al_xGa_{1-x}N$ material with x less than 0.2**;

(2) Prior art reference(s) teach or suggest a gallium nitride-based HEMT device having a InGaN channel layer and a GaN layer over such channel layer; or

(3) Prior art reference(s) teach or suggest a gallium nitride-based HEMT device having a InGaN channel layer and an InGaN layer over such channel layer.

With respect to aspect (1) of claim 1, the Examiner recognized the limitation of the primary reference Hiroharu, which only discloses an n-AlGaN layer with mole fraction of Al equal to (but not less than) 0.2, and required the Applicants to establish the criticality of using AlGaN material having Al mole fraction of less than 0.2 in the July 30, 2003 Office Action.

Per such requirement, Applicants has filed a Response on September 8, 2003, in which Applicants extensively discussed **the advantages of using AlGaN material of reduced Al content (i.e., less than 0.2), such as (1) preventing defect-donor complexes (DX centers) formation and (2) reducing the persistent photoconductivity (PPC) and drain I-V collapse** (see instant specification, page 3, lines 19-20), **which were not recognized or even contemplated by the conventional wisdom that favors AlGaN material of high Al content (i.e., equal to or more than 0.2)**.

In addition, a portion of U.S. Patent No. 6,639,225 filed on December 8, 2000 (after the filing of the present application) in the names of Inoue et al. for "GaN-Based HFET Having a Surface-Leakage Reducing Layer" discussed the conventional wisdom regarding AlGaN/GaN heterostructure in its Background section. Specifically, it states that "[when] Al composition of AlGaN of the electron donor layer 904 is **0.2 to 0.3**, electron density of the channel layer 903 is about $1\times10^{13}/cm^2$, which is about 3 times the density of a GaAs-based device," which is important for forming "a highly promising power device" (see Inoue, column 2, lines 14-21). Such disclosure in Inoue **corroborates** the statement on page 3, lines 11-24 of the instant specification regarding **the conventional wisdom that favors AlGaN material of high Al content (i.e., >0.20)** for achieving high sheet densities via piezoelectric-induced doping in the AlGaN/GaN heterostructure.

Therefore, Applicants have met their burden of establishing the criticality of using AlGaN material having Al mole fraction of less than 0.2 in the claimed invention.

Because neither the primary reference Hiroharu nor the secondary reference Streit et al. teaches or suggests use of AlGaN material having Al content of less than 0.2, and because the

conventional wisdom favors AlGaN material of high Al content that is equal to or more than 0.2, Applicants' claimed invention, which requires a gallium nitride-based HEMT device having a InGaN channel layer and thereover an AlGaN layer of low Al content that is less than 0.2, therefore patentably distinguishes over the Hiroharu and Streit references, as stated in Applicants' September 8, 2003 Response.

Despite such patentable distinctions between Applicants' claimed invention as recited in claim 1 and the cited references Hiroharu and Streit, the Examiner still concluded in the October 16, 2003 Advisory Action that "[the] combination of Hiroharu and Streit et al. meets the limitations of claim 1," **without providing any factual or evidentiary support for such conclusion**.

The Examiner is hereby reminded that "[mere] denials and conclusory statements, however, are not sufficient to establish a genuine issue of material fact." *In re Dembiczak*, 50 USPQ2d 1614 (Fed. Cir. 1999), citing *McElmurry v. Arkansas Power & Light Co.*, 27 USPQ2d 1129 (Fed. Cir. 1993).

When a critical element of claim 1 of the present application is not taught or disclosed in any manner by the hypothetical combination of the Hiroharu and Streit et al. references, **the Examiner has not satisfied his burden to establish a *prima facie* case of obviousness**, and moreover, **he is not allowed to fill in such gap between Applicants' claimed invention and the teachings of the cited references by making unsupported denials or conclusory statements, without any evidentiary support**.

With respect to aspect (3) of claim 1, the Examiner in the July 30, 2003 Office Action has mischaracterized the teachings of the Hiroharu reference, and on the basis of such mischaracterization, concluded that the Hiroharu reference implicitly discloses an InGaN/InGaN HEMT device, as recited by claim 1 of the present application.

In the September 8, 2003 Response, Applicants have rebutted such mischaracterization of the Hiroharu reference by the Examiner, in support of the fact that Hiroharu reference does not in any manner teach or suggest an InGaN/InGaN HEMT device, either expressly or implicitly.

The Examiner did not in any manner respond to Applicants' rebuttal in the October 16, 2003 Advisory Action, and it is therefore assumed that the Examiner agrees with the Applicants and concedes the fact that he has previous mischaracterized the Hiroharu reference.

Therefore, claim 1 and its dependent claims 2-9 and 35-42 are patentably distinguished over the Hiroharu and Streit references.

The Examiner is hereby requested to reconsider, and upon reconsideration to withdraw, the rejections of pending claims 1-9 and 35-42.

If the Examiner persists with such claim rejections, Applicants will of necessity be forced to appeal the final rejections in order to obtain the appropriate allowance of the pending claims. This response is intended to obviate such necessity of appeal, since the basis for patentability of Applicants' pending claims is so apparent. The Examiner therefore is requested to take cognizance of the clear and compelling basis of patentability of the pending claims, and to correspondingly allow claims 1-9 and 35-42.

CONCLUSION

No fee is rendered payable herein. Nevertheless, the Office is authorized charge any fee that is deemed necessary for entry of this Amendment to Deposit Account No. 08-3284 of Intellectual Property/Technology Law.

If any issues remain outstanding, incident to the formal allowance of the application, the Examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss same, in order that this application may be allowed and passed to issue at an early date.

Respectfully submitted,

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APPENDIX A

Clean Copy of All Pending Claims

1. A gallium nitride-based HEMT device, comprising a channel layer comprising an InGaN alloy and at least one additional layer over said channel layer, wherein said at least one additional layer comprises material selected from the group consisting of AlGaN, GaN, and InGaN, with the proviso that when said at least one additional layer comprises AlGaN material, said AlGaN material is $Al_xGa_{1-x}N$, wherein x is less than 0.2.

2. The device of claim 1, wherein said at least one additional layer comprises AlGaN material, forming an AlGaN/InGaN heterostructure with the channel layer.

3. The device of claim 2, further comprising a GaN layer underneath said channel layer.

4. The device of claim 1, which does not comprise an aluminum-containing layer.

5. The device of claim 4, wherein said at least one additional layer comprises GaN material, forming a GaN/InGaN HEMT with the channel layer.

6. The device of claim 4, wherein said at least one additional layer comprises InGaN material, forming an InGaN/InGaN HEMT with the channel layer.

7. The device of claim 2, wherein said AlGaN material is doped.

8. The device of claim 2, wherein the AlGaN material is undoped.

9. The device of claim 7, wherein the AlGaN material comprises a dopant providing an increased sheet density in relation to a corresponding undoped AlGaN layer.

35. The device of claim 2, wherein said AlGaN material is $Al_xGa_{1-x}N$, wherein x is about 0.1.

36. The device of claim 1, wherein the channel layer comprising an InGaN alloy has a thickness in a range of from about 100 to about 5000 nanometers.

37. The device of claim 1, wherein the channel layer comprising an InGaN alloy has a thickness in a range of from about 200 to about 2000 nanometers.

38. The device of claim 1, wherein the channel layer comprising an InGaN alloy has a thickness in a range of from about 400 to about 1000 nanometers.

39. The device of claim 1, comprising:

a substrate;

a GaN buffer layer on said substrate;

said channel layer on said GaN buffer layer;

said at least one additional layer on said channel layer, said at least one additional layer comprising undoped AlGaN material and forming an AlGaN spacer layer; and

a doped AlGaN donor layer on said AlGaN spacer layer.

40. The device of claim 1, comprising:

a substrate;

a GaN buffer layer on said substrate;

said channel layer on said GaN buffer layer;

said at least one additional layer on said channel layer, said at least one additional layer comprising undoped GaN material and forming a GaN spacer layer; and

a doped GaN donor layer on said GaN spacer layer.

41. The device of claim 1, comprising:

a substrate;

a GaN buffer layer on said substrate;

said channel layer on said GaN buffer layer;

said at least one additional layer on said channel layer, said at least one additional layer comprising undoped InGaN material and forming an InGaN spacer layer; and

a doped InGaN donor layer on said InGaN spacer layer,

wherein said InGaN spacer layer has a lower InN concentration than said channel layer.

42. The device of claim 39, further comprising a two dimensional electron gas (2DEG) between the InGaN channel layer and the AlGaN spacer layer.